

Table 5 Structural Measures (adapted from Seago, 2000)

Study Setting	Study design; Outcomes	Availability of Nurse	Effect Size (coefficient, mean difference, OR*)
1. Case control study in one tertiary teaching hospital in St Louis, Missouri in 2002.	Level 3; Level 1	Patient to nurse ratio obtained from nurse staffing records (≤ 3 ; 4-6; ≥ 7)	Multivariate model with patient related factors for falling included increasing patient to nurse ration (OR 1.6% CI: 1.2-2.0)
1. Cross sectional data were collected on 232,342 surgical patients (general, orthopedic, and vascular surgery) discharged from 168 general hospitals in Pennsylvania between April 1998 – November 1999 ^{11,12}	Level 3; Level 1&3	50% of hospitals had nurse-patient ratio that was 1:5 or lower; 39.6% nurses had BSN or higher	Controlling for patient and hospital characteristics nurse to patient ratio was significantly associated with 30-day mortality (OR 1.07, 95% CI: 1.03-1.12, $p < 0.001$) and failure to rescue (OR 1.07, 95% CI: 1.02-1.11, $p < 0.001$).
2. Prospective data collected from 1,205 consecutively admitted AIDS patients in 40 units in 20 acute care hospitals. 820 (86%) RNs & LPNs were also surveyed. Hospitals from 11 US states participated ¹³	Level 3; Level 1&3	0.8 mean nurses/ patient day with a range of (0.5-1.5) nurses/ patient day	RN/LPN Nurse to patient ratio was significantly associated with 30-day mortality (OR 0.46, 95% CI: 0.22-0.98, $p < 0.01$). An additional nurse per patient day reduced the odds of dying by one-half.
3. All SICU patients who developed a central venous catheter bloodstream infection during an infection outbreak period (January 1992 through September 1993) and randomly selected controls. Cohort study: all SICU patients during the study period (January 1991 through September 1993) ¹⁴	Level 3; Level 1	1.2 patient/ nurse and 20 nursing hours per patient day (HPPD) 1.5 patient/ nurse and 16 nursing HPPD 2 patient/ nurse and 12 nursing HPPD	There was a significant relationship between nurse to patient ratios and nursing hours and central venous catheter bloodstream infection in the SICU. For 1.2 patient/ nurse and 20 HPPD the adjusted odds ratio was 3.95 (95% CI: 1.07-14.54). 1.5 patient/ nurse and 16 nursing HPPD, 15.6 (95% CI: 1.15-211.4), and for 2 patients/ nurse and 12 HPPD, 61.5 (95% CI: 1.23-3074).
4. Cross sectional data from 39 nursing units in 11 hospitals for 10 quarters of data between July, 1993 and December, 1995 in the US ¹⁵	Level 3; Level 1&2	Proportion of direct care RN hours; total direct care hours; Up to 87.5% RN skill mix	With patient acuity controlled, direct care RN proportion of hours was inversely associated with medication errors (-0.525, $p < 0.05$) and decubiti (-0.485, $p < 0.05$). Total direct care hours was positively associated with mortality (0.491, $p < 0.05$). A curvilinear relationship was found so that as RN proportion increased, rates of all adverse events decreased up to a proportion of 88% RNs. Above that level, as RN proportion increased, the adverse outcomes increased.

5. 42 inpatient units in one 880-bed hospital in the US ¹⁶	Level 3; Level 1&2	8.63 mean total hours of care; 69% RN skill mix; Up to 85% skill mix	With patient acuity controlled, direct care RN proportion of hours was inversely associated with medication errors/doses (-0.576, p<0.05) and falls (-0.456, p<0.05). Total direct care hours was positively associated with medication errors/doses (0.497, p<0.05). A curvilinear relationship was found so that as RN proportion increased, medication error rates decreased up to a proportion of 85% RNs. Above that level, as RN proportion increased, the medication error increased.
6. Cross sectional data from hospital cost disclosure reports and patient discharge abstracts from acute care hospitals in California and New York for fiscal years 1992 and 1994 ¹⁷	Level 3; Level 1&2	7.56-8.43 mean total hours of care/ nursing intensity weight (NIW); 67.7% to 70.5% RN skill mix	Total hours/NIW was inversely associated with pressure ulcer rates (-15.59, p<0.01). RN hours in California, but not New York, was inversely associated with pneumonia (-0.39, p<0.01).
7. Cross sectional data from hospital cost disclosure reports, patient discharge abstracts and Medicare data from acute care hospitals in Arizona, California, Florida, Massachusetts, New York, and Virginia for 1996 ¹⁸	Level 3; Level 1&2	5.76 mean licensed hours of care/83.3% RN skill mix	Skill mix was inversely associated with pneumonia (-0.20, p<0.01), postoperative infection (-0.38, p<0.01), pressure ulcers (-0.47, p<0.01), and urinary tract infections (-0.61, p<0.01).
8. Cross sectional data from hospital cost disclosure reports, patient discharge abstracts from acute care hospitals in California, Massachusetts, and New York for 1992 and 1994 ¹⁹	Level 3; Level 1&2	7.67-8.43 mean total hours of care; 67.7-70.5% skill mix	RN hours were inversely associated with pneumonia (-0.39, p<0.01), pressure ulcer rates (-1.23, p<0.01), and postoperative infection (-0.47, p<0.01).
9. Cross sectional data from HCFA Medicare Hospital Mortality Information 1986 and the American Hospital Association 1986 annual survey of hospitals ²⁰	Level 3; Level 1	0.9 mean RN/ADC (average daily census); 60% skill mix	Controlling for hospital characteristics, proportion of RNs/all nursing staff was significantly associated to adjusted 30-day mortality rate (adjusted difference between lower and upper fourth of hospitals -2.5, 95% CI: -4.0 to -0.9).
10. Cross sectional data from the American Hospital Association 1986 annual survey of hospitals and medical record reviews from July 1987 to June 1988 in 6 large PPOs ²¹	Level 3; Level 3	52.2 (Texas) – 67.6% (California) skill mix	Controlling for hospital characteristics, proportion of RNs/ all nursing staff was significantly related to lower problem rates (California lower rates 3.58, upper rates 2.30 p<0.0001)
11. Cross sectional data from the American Hospital Association Annual Survey of	Level 3; Level 1	67.8% mean skill mix	Proportion of RN FTE/ all nursing FTEs was inversely related to thrombosis after major surgery

Hospitals for 1993 and the Nationwide Inpatient Sample from the Agency for Health Care Policy and Research for 1993 (HCUP) ²²			(beta -33.22, 95% CI: -57.76 to -8.687), urinary tract infection after surgery (beta -159.41 to -421.15), and pneumonia after major surgery (beta -159.41, 95% CI: -252.67 to -66.16).
12. Cross sectional data were collected from March 1 to June 7, 1986 and included 497 patients ²³	Level 3; Level 2	Adequate staffing	The adequately staffed unit had fewer complications than the inadequately staffed unit.
13. 390 patients admitted within 1 week after stroke onset in 9 acute care hospitals in The Netherlands. Surviving patients were interviewed 6 months post stroke and asked about falls. Fall and other patient data were collected from medical records. Ward characteristics were provided by senior nurses. Complete data on 340 patients ²⁴	Level 3; Level 2	0.04 mean difference in nurse to patient ratios	No significant differences in falls between case and control groups in number of nurses or nurse ratios on any shift.
14. Cross sectional data for 17,440 patients across 42 ICUs in the US ²⁵	Level 3; Level 1-3	Mean 0.66 patient/nurse with a range of 0.31-1.31	Neither nurse to patient ratio nor caregiver interaction was found to be significantly associated with risk-adjusted mortality.
15. Cross sectional data were collected from April, 1994-March, 1995 from 23 trusts (groups of hospitals) in Scotland ²⁶	Level 3; Level 1	Mean RN FTE was 1.21 per patient	There was no association between RN FTE per occupied hospital bed and mortality
16. Cross sectional data were collected from the American Hospital Association Annual survey of Hospitals in 1989-1991, the observed and predicted 30-day post-admission mortality for patients with a primary diagnosis of COPD from the HCFA Hospital Information Reports from 1989-1991 and the Medicare Case Mix Index ²⁷	Level 3; Level 1	RN FTE/ 100 adjusted admissions	No association between RN FTE/100 adjusted admissions and 30-day post-admission mortality for patients with COPD
17. Cross sectional data from staffing and accounting records of 60 community hospitals across the US in 1985, hospital and nursing unit surveys, 1981 case mix indexes from the Federal Register, and the Health Area Resources File ²⁸	Level 3; Level 3	52% RN skill mix; 33% LPN mean nursing HPPD was 4.93	No significant associations between staffing variables, medication errors, patient injuries, IV administration errors, and treatment errors.

*OR=odds ratio